

AF: Amended  
9/28/2007

**In the Claims**

**1. (currently amended)** An antistatic polymer composition comprising

a) a polymer substrate selected from the group consisting of ~~the~~ polyolefins, polyesters, polyamides and polylactic acids and

b) a combination of

i) at least one permanent antistatic additive selected from the group consisting of ~~the~~ polyetheresteramides and

ii) at least one migratory antistatic additive selected from the group consisting of straight or branched chain ~~C<sub>10</sub>-C<sub>48</sub> alkylsulfonic acid salts, alkyl diethanolamines and alkyl~~ diethanolamides. C<sub>n</sub>

**2. (original)** A composition according to claim 1 in which the polyetheresteramides are aliphatic polyetheresteramides.

**3. (original)** A composition according to claim 1 in which the polyetheresteramides are aromatic polyetheresteramides.

**4. (original)** A composition according to claim 2 wherein the polyetheresteramide consists essentially of residues derived from (1) a polyamide oligomer having carboxylic end groups and having a number average molecular weight of from about 200 to about 15,000 and (2) a polyoxyalkylene glycol having a number average molecular weight of from about 200 to about 6,000.

**5. (original)** A composition according to claim 4 where the carboxylic group is derived from adipic, sebacic, terephthalic or isophthalic acids or 3-sulfoisophthalic acid alkali metal and the

polyoxyalkylene glycol is polyethylene glycol.

**6. (original)** A composition according to claim 3 wherein the polyetheresteramide consists essentially of residues derived from (1) a polyamide oligomer having carboxylic end groups and having a number average molecular weight of from about 200 to about 15,000 and (2) a polyoxyalkylated bisphenol compound having a number average molecular weight of from about 200 to about 6,000.

**7. (original)** A composition according to claim 6 where the carboxylic group is derived from adipic, sebacic, terephthalic or isophthalic acids or 3-sulfoisophthalic acid alkali metal and wherein the polyoxyalkylated bisphenol compound is a polyoxyalkylated alkylidene bisphenol.

**8. (previously presented)** A composition according to claim 6 wherein the polyoxyalkylated bisphenol is an ethylene oxide adduct of bisphenol A.

**9-15. (canceled)**

**16. (currently amended)** A composition according to claim 1~~[[5]]~~ where alkyl is straight or branched chain C<sub>2</sub>-C<sub>22</sub>alkyl.

**17. (currently amended)** A composition according to claim 1~~[[5]]~~ where alkyl is straight or branched chain C<sub>10</sub>-C<sub>18</sub> alkyl.

**18. (currently amended)** A composition according to claim 1~~[[5]]~~ where the ~~alkyl diethanolamines and the alkyl diethanolamides are hydrogenated tallow bis(2-hydroxyethyl)amine, tridecyl bis(2-hydroxyethyl)amine, pentadecyl bis(2-hydroxyethyl)amine, lauryl bis(2-hydroxyethyl)amine~~~~[[.]]~~

hydrogenated tallow bis(2-hydroxyethyl)amide, tridecyl bis(2-hydroxyethyl)amide, pentadecyl bis(2-hydroxyethyl)amide or lauryl bis(2-hydroxyethyl)amide.

**19. (currently amended)** A composition according to claim 1[[5]] where the migratory additive is lauryl bis(2-hydroxyethyl)amide, CAS# 120-40-1.

**20. (original)** A composition according to claim 1 where the polymer substrate is polyethylene, polypropylene, polyethylene/polypropylene copolymer, polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polyamide 4, polyamide 6, polyamide 6,6, polyamide 6,10, polyamide 6,9, polyamide 6,12, polyamide 4,6, polyamide 12,12, polyamide 11, polyamide 12 and polylactic acid.

**21. (original)** A composition according to claim 1 where the polyetheresteramides of component i) are present from about 0.5% to about 15% by weight, based on the weight of the polymer substrate.

**22. (original)** A composition according to claim 1 where the polyetheresteramides of component i) are present from about 1% to about 10% by weight, based on the weight of the polymer substrate.

**23. (original)** A composition according to claim 1 where the migratory additives of component ii) are present from about 0.05% to about 2% by weight, based on the weight of the polymer substrate.

**24. (original)** A composition according to claim 1 where the migratory additives of component ii) are present from about 0.05% to about 1% by weight, based on the weight of the polymer substrate.

**25. (currently amended)** An antistatic additive mixture comprising

i) at least one permanent antistatic additive selected from the group consisting of polyetheresteramides and

ii) at least one migratory antistatic additive selected from the group consisting of straight or branched chain ~~C<sub>10</sub>-C<sub>18</sub> alkylsulfonic acid salts, alkyl diethanolamines and alkyl diethanolamides.~~

**26. (currently amended)** A process for the preparation of antistatically finished polymers selected from the group consisting of polyolefins, polyesters, polyamides and polylactic acids,

which process comprises mixing an additive mixture comprising

i) at least one permanent antistatic additive selected from the group consisting of polyetheresteramides and

ii) at least one migratory antistatic additive selected from the group consisting of straight or branched chain ~~C<sub>10</sub>-C<sub>18</sub> alkylsulfonic acid salts, alkyl diethanolamines and alkyl diethanolamides,~~

as such or in the form of its individual components and together with optional further additives with said polymers in calenders, mixers, kneaders or extruders.

4/30/2007

**In the Claims**

~~1~~ **(currently amended)** An antistatic polymer composition comprising

a) a polymer substrate selected from the group consisting of ~~the~~ polyolefins, polyesters, polyamides and polylactic acids and

b) a combination of

i) at least one permanent antistatic additive selected from the group consisting of ~~the~~ polyetheresteramides and

ii) at least one migratory antistatic additive selected from the group consisting of ~~the~~ straight or branched chain C<sub>10</sub>-C<sub>18</sub>alkylsulfonic acid salts, the alkyl diethanolamines and the alkyl C<sub>n</sub> diethanolamides.

~~2~~ **(original)** A composition according to claim 1 in which the polyetheresteramides are aliphatic polyetheresteramides.

~~3~~ **(original)** A composition according to claim 1 in which the polyetheresteramides are aromatic polyetheresteramides.

~~4~~ **(original)** A composition according to claim 2 wherein the polyetheresteramide consists essentially of residues derived from (1) a polyamide oligomer having carboxylic end groups and having a number average molecular weight of from about 200 to about 15,000 and (2) a polyoxyalkylene glycol having a number average molecular weight of from about 200 to about 6,000.

~~5~~ **(original)** A composition according to claim 4 where the carboxylic group is derived from adipic, sebacic, terephthalic or isophthalic acids or 3-sulfoisophthalic acid alkali metal and the

polyoxyalkylene glycol is polyethylene glycol.

~~6. (original)~~ A composition according to claim 3 wherein the polyetheresteramide consists essentially of residues derived from (1) a polyamide oligomer having carboxylic end groups and having a number average molecular weight of from about 200 to about 15,000 and (2) a polyoxyalkylated bisphenol compound having a number average molecular weight of from about 200 to about 6,000.

~~7. (original)~~ A composition according to claim 6 where the carboxylic group is derived from adipic, sebacic, terephthalic or isophthalic acids or 3-sulfoisophthalic acid alkali metal and wherein the polyoxyalkylated bisphenol compound is a polyoxyalkylated alkylidene bisphenol.

~~8. (currently amended)~~ A composition according to claim 6 wherein the polyoxyalkylated bisphenol is an the ethylene oxide adduct of bisphenol A.

0 ~~9. (original)~~ A composition according to claim 1 where the migratory antistatic additives are selected from the group consisting of the alkylsulfonic acid salts. 50'

10. (canceled) ✓

11. (canceled)

0 ~~12. (currently amended)~~ A composition according to claim 9 where the alkylsulfonic acid salts comprise a counterion selected from the group consisting of the alkali metal cations, alkaline earth metal cations and zinc cation. 50'

~~13.~~ (currently amended) A composition according to claim 9 where the alkylsulfonic acid salts comprise a counterion selected from the group consisting of the cations of Li, Na, K, Ca, Mg and Zn. *ob'*

~~14.~~ (original) A composition according to claim 9 where the alkylsulfonic acid salts are a mixture of C<sub>10</sub>-C<sub>18</sub> alkylsulfonic acid sodium salts, CAS # 68037-49-0. *ob'*

~~15.~~ (original) A composition according to claim 1 where the migratory antistatic additives are selected from the group consisting of the alkyl diethanolamines and the alkyl diethanolamides. *C<sub>n</sub>*

~~16.~~ (original) A composition according to claim 15 where alkyl is straight or branched chain C<sub>2</sub>-C<sub>22</sub> alkyl. *C<sub>n</sub> - C<sub>22</sub>*

~~17.~~ (original) A composition according to claim 15 where alkyl is straight or branched chain C<sub>10</sub>-C<sub>18</sub> alkyl. *C<sub>10</sub> - C<sub>18</sub>*

~~18.~~ (original) A composition according to claim 15 where the alkyl diethanolamines and the alkyl diethanolamides are hydrogenated tallow bis(2-hydroxyethyl)amine, tridecyl bis(2-hydroxyethyl)amine, pentadecyl bis(2-hydroxyethyl)amine, lauryl bis(2-hydroxyethyl)amine, hydrogenated tallow bis(2-hydroxyethyl)amide, tridecyl bis(2-hydroxyethyl)amide, pentadecyl bis(2-hydroxyethyl)amide or lauryl bis(2-hydroxyethyl)amide.

~~19.~~ (original) A composition according to claim 15 where the migratory additive is lauryl bis(2-hydroxyethyl)amide, CAS# 120-40-1.

~~20.~~ (original) A composition according to claim 1 where the polymer substrate is polyethylene, polypropylene, polyethylene/polypropylene copolymer, polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polyamide 4, polyamide 6, polyamide 6,6, polyamide 6,10,

polyamide 6,9, polyamide 6,12, polyamide 4,6, polyamide 12,12, polyamide 11, polyamide 12 and polylactic acid.

~~21. (original)~~ A composition according to claim 1 where the polyetheresteramides of component i) are present from about 0.5% to about 15% by weight, based on the weight of the polymer substrate.

~~22. (original)~~ A composition according to claim 1 where the polyetheresteramides of component i) are present from about 1% to about 10% by weight, based on the weight of the polymer substrate.

~~23. (original)~~ A composition according to claim 1 where the migratory additives of component ii) are present from about 0.05% to about 2% by weight, based on the weight of the polymer substrate.

~~24. (original)~~ A composition according to claim 1 where the migratory additives of component ii) are present from about 0.05% to about 1% by weight, based on the weight of the polymer substrate.

25. (currently amended) An antistatic additive mixture comprising

i) at least one permanent antistatic additive selected from the group consisting of the polyetheresteramides and

ii) at least one migratory antistatic additive selected from the group consisting of the straight or branched chain C<sub>10</sub>-C<sub>18</sub>alkylsulfonic acid salts, the alkyl diethanolamines and the alkyl diethanolamides.

*withdrawn*

26. (currently amended) A process for the preparation of antistatically finished polymers selected from the group consisting of polyolefins, polyesters, polyamides and polylactic acids,

which process comprises mixing an additive mixture comprising



i) at least one permanent antistatic additive selected from the group consisting of ~~the~~ polyetheresteramides and

ii) at least one migratory antistatic additive selected from the group consisting of ~~the~~ straight or branched chain C<sub>10</sub>-C<sub>18</sub>alkylsulfonic acid salts, ~~the~~ alkyl diethanolamines and ~~the~~ alkyl diethanolamides,

as such or in the form of its individual components and together with optional further additives with said polymers in calenders, mixers, kneaders or extruders.

The finished antistatic polymer articles are for example fibers, films, molded articles and foamed articles.

The following Examples illustrate the invention in more detail. Unless otherwise stated, parts and percentages are by weight.

### **Experimental**

Polymer resin is blended with antistatic additives by using a Turbula mixer for 15-20 minutes. Total formulation size was 1000g. The mixtures are then extruded with a 27 mm Leistritz twin screw extruder. The extrusion is conducted at 425-475°F for LDPE, 390-410°F for PP, and 320-375°F for PLA. The obtained resin is pelletized with a cutter. MPM blown film extruder is then employed to make film from LDPE and PP pelletized resin. PLA resin is injection molded into plaques. PP fiber is spun from the pelletized PP resin by using a Hills Fiber Extruder. The spun fiber is about 15 dpf.

Static decay time is measured with ETS (electro-tech systems) Static Decay Meter on LDPE and PP films and PLA plaques. Results are in the tables below. The measurement of 100 sec is poor. A measurement of >100 sec is recorded as 100 sec.

Surface Resistivity is measured in ohms/sq. The lower the value the more conductive the sample is.

**Antistatic additives:**

**Migratory:**

**Additive M1:** mixture of C<sub>10</sub>-C<sub>18</sub> alkylsulfonic acid sodium salts, CAS # 68037-49-0

**Additive M2:** lauryl bis(2-hydroxyethyl)amide, CAS# 120-40-1

**Permanent:**

**Additive P1:** hexanedioic acid, polymer with azacyclotridecan-2-one and  $\alpha$ -hydro- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl) CAS# 70290-02-7

**Additive P2:** 47% hexanedioic acid, polymer with azacyclotridecan-2-one and  $\alpha$ -hydro- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl) CAS# 70290-02-7; 50% azacyclotridecan-2-one, homopolymer, CAS# 25038-74-8; and 2% perchloric acid, sodium salt, monohydrate CAS# 7791-07-3

The additive level is weight percent based on the entire formulation.

Polypropylene (PP) film

antistatic additive	Static Decay Time (seconds)		
	initial	1 week	4 weeks
none	100	100	100
1% M1	100	18.3	0.67
4% P1	100	100	100
8% P1	100	100	100
4% P2	100	100	100
8% P2	100	100	100
1% M1 + 4% P1	1.58	0.13	0.05
1% M1 + 8% P1	0.11	0.05	0.04
1% M1 + 4% P2	1.22	0.10	0.07
1% M1 + 8% P2	0.03	0.01	0.01

Polypropylene (PP) fiber

antistatic additive	Surface Resistivity (ohms/sq)			
	initial	1 day after first wash	1 day after second wash	7 weeks after second wash
none	5.8E+09	1.0E+15	8.9E+14	1.0E+15
1% M1	5.7E+09	5.5E+14	1.8E+15	4.7E+14
1% M2	5.4E+09	3.2E+14	1.9E+15	5.9E+14
5% P2	3.4E+09	4.6E+13	1.7E+14	1.2E+14
1% M1 + 5% P2	3.0E+09	8.9E+12	2.7E+13	2.3E+12
1% M2 + 5% P2	4.4E+09	4.6E+12	5.3E+12	4.1E+12

**Polylactic acid (PLA) plaques**

antistatic additive	Static Decay Time (seconds)				
	1 day	5 days	2 weeks	1 month	2 months
none	100	100	100	100	100
1.0% M1	100	0.75	0.74	0.50	0.64
4% P2	100	100	100	100	100
1% M1 + 4% P2	3.10	1.32	0.96	0.78	0.82

**Low Density Polyethylene (LDPE) film**

antistatic additive	Static Decay Time (seconds)				
	7 days	14 days	1 month	2 months	4 months
none	100	100	100	100	100
0.05% M1	100	100	100	100	100
0.2% M1	100	100	100	100	100
4% P2	100	100	100	100	100
6% P2	100	8.85	5.81	100	2.53
0.05% M1 + 4% P2	0.79	0.29	0.24	0.88	0.26
0.2% M1 + 4% P2	0.04	100	0.04	0.08	0.03
0.05% M1 + 6% P2	0.31	0.07	0.15	0.04	0.10
0.2% M1 + 6% P2	0.02	0.02	0.02	0.02	0.02

### Polylactic acid (PLA) plaques

antistatic additive	Static Decay Time (seconds)				
	1 day	5 days	2 weeks	1 month	2 months
none	100	100	100	100	100
1.0% M1	100	0.75	0.74	0.50	0.64
4% P2	100	100	100	100	100
1% M1 + 4% P2	3.10	1.32	0.96	0.78	0.82

### Low Density Polyethylene (LDPE) film

antistatic additive	Static Decay Time (seconds)				
	7 days	14 days	1 month	2 months	4 months
none	100	100	100	100	100
0.05% M1	100	100	100	100	100
0.2% M1	100	100	100	100	100
4% P2	100	100	100	100	100
6% P2	100	8.85	5.81	100	2.53
0.05% M1 + 4% P2	0.79	0.29	0.24	0.88	0.26
0.2% M1 + 4% P2	0.04	100	0.04	0.08	0.03
0.05% M1 + 6% P2	0.31	0.07	0.15	0.04	0.10
0.2% M1 + 6% P2	0.02	0.02	0.02	0.02	0.02